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Jaenke et al.

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(54) **METHOD AND APPARATUS FOR PROGRAMMING PARAMETERS OF A POWER DRIVEN WHEELCHAIR FOR A PLURALITY OF DRIVE SETTINGS**

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(52) **U.S. Cl.**
USPC **701/22**; 701/36; 180/65.8

(58) **Field of Classification Search** 701/22, 701/36; 180/65.8
See application file for complete search history.

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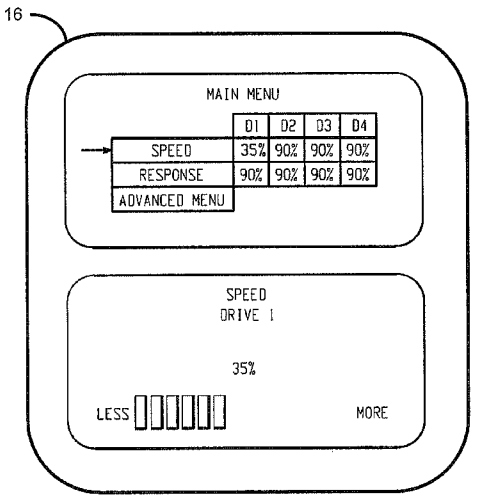
(57) **ABSTRACT**

A method of programming parameters of a power driven wheelchair for a plurality of drive modes comprises: displaying a menu image on an interactive display screen, the menu image including settings of a plurality of wheelchair parameters for a plurality of drive modes of the wheelchair; selecting a wheelchair parameter for a drive mode from the displayed menu image; and programming the setting of the selected wheelchair parameter to a desired setting.

19 Claims, 14 Drawing Sheets



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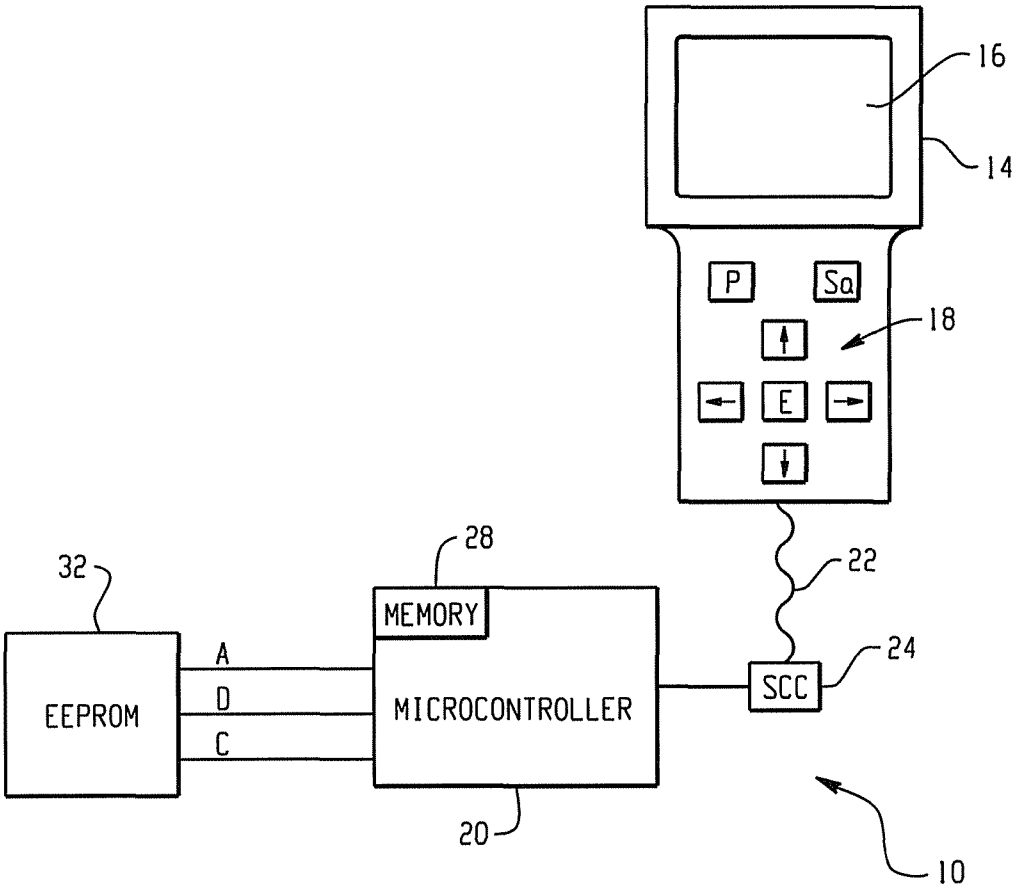
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Fig. 1

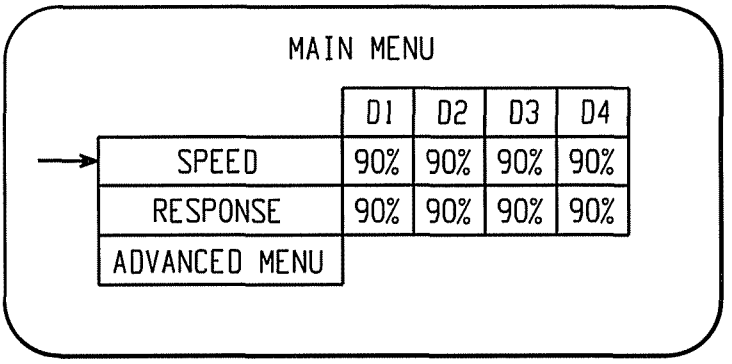

Fig. 1A

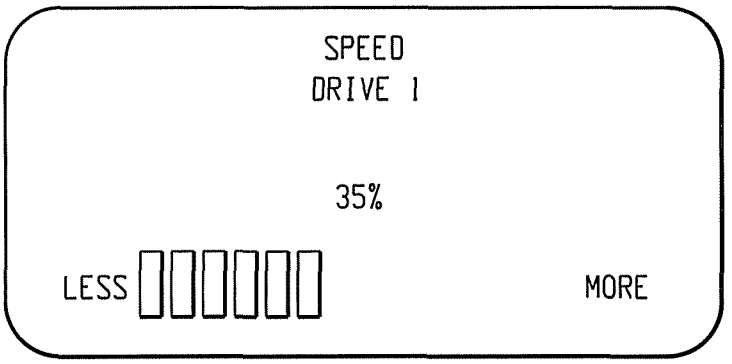

Fig. 1B

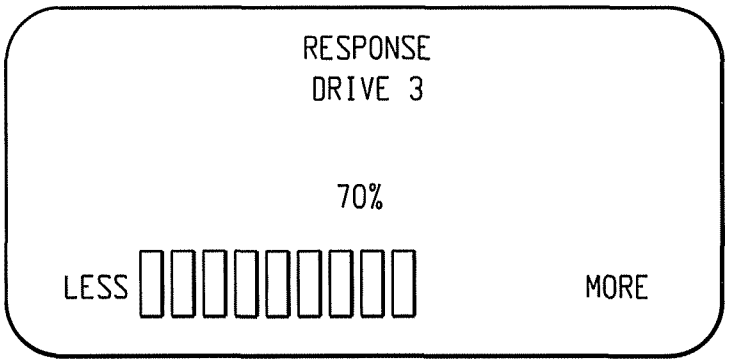

Fig. 1C

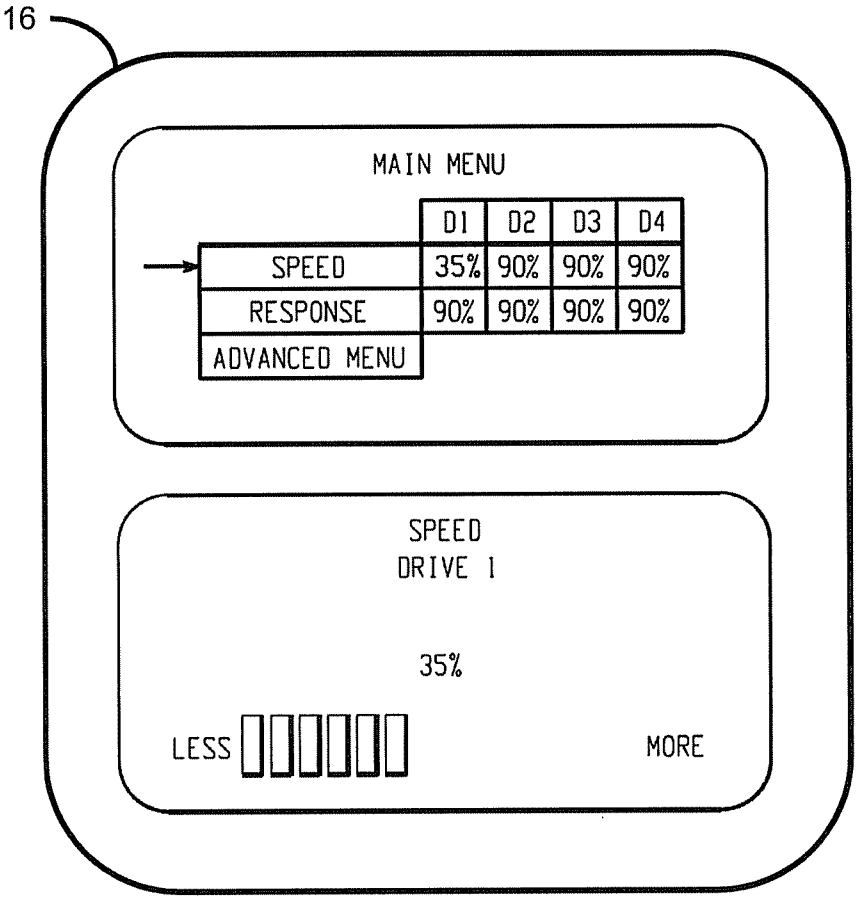
16
MAIN MENU
D1
D2
D3
D4
SPEED
35%
90%
90%
90%
RESPONSE
90%
90%
90%
90%
ADVANCED MENU
SPEED
DRIVE 1
35%
LESS
MORE

Fig. 1D

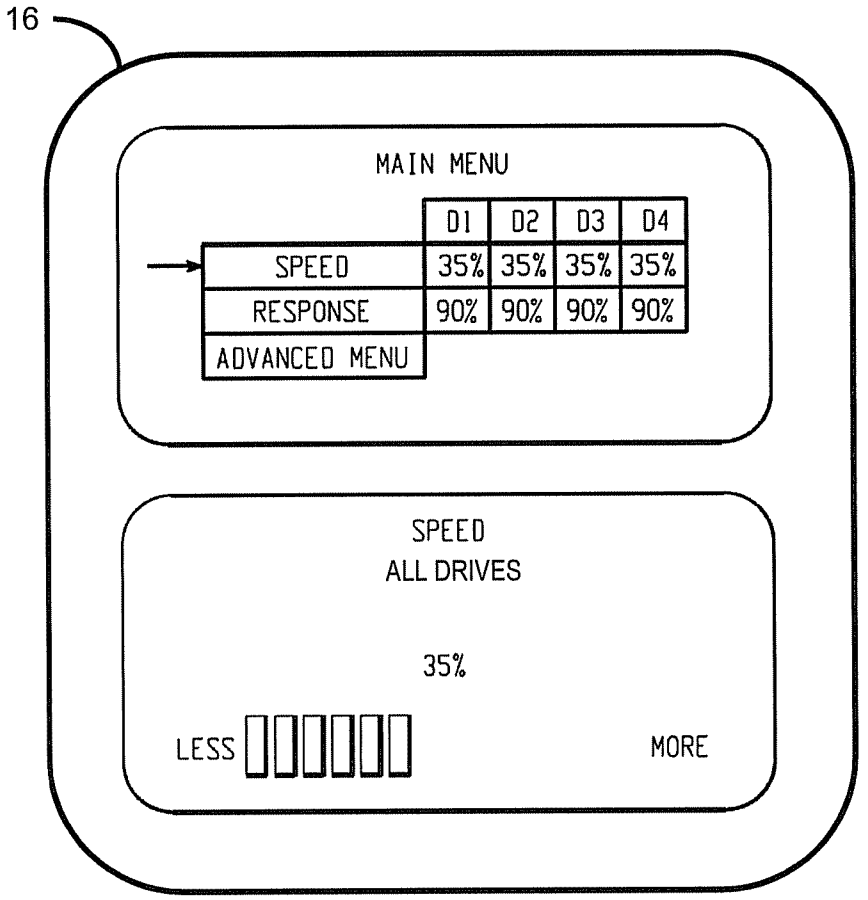
16
MAIN MENU
D1 D2 D3 D4
SPEED 35% 35% 35% 35%
RESPONSE 90% 90% 90% 90%
ADVANCED MENU
SPEED
ALL DRIVES
35%
LESS
MORE

Fig. 1E

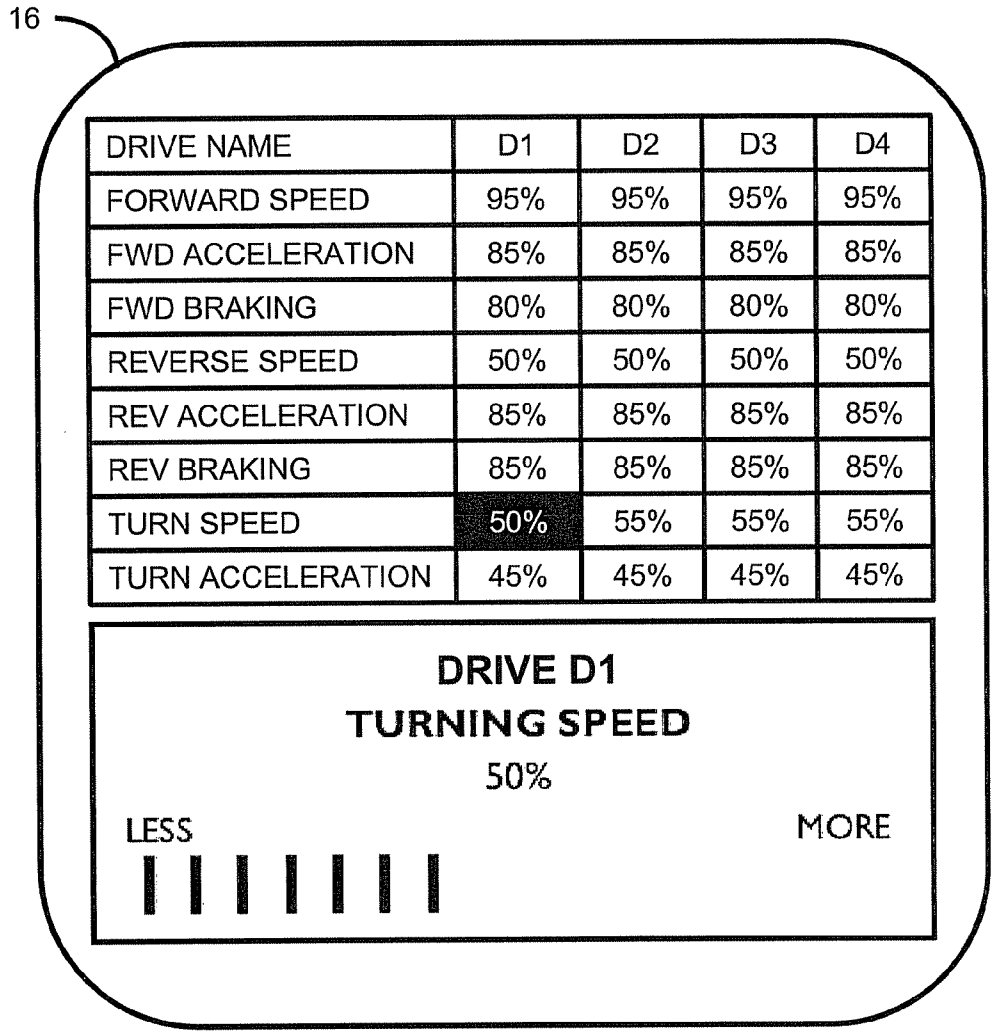
16
DRIVE NAME
D1
D2
D3
D4
FORWARD SPEED
95%
95%
95%
95%
FWD ACCELERATION
85%
85%
85%
85%
FWD BRAKING
80%
80%
80%
80%
REVERSE SPEED
50%
50%
50%
50%
REV ACCELERATION
85%
85%
85%
85%
REV BRAKING
85%
85%
85%
85%
TURN SPEED
50%
55%
55%
55%
TURN ACCELERATION
45%
45%
45%
45%
DRIVE D1
TURNING SPEED
50%
LESS
MORE

Fig. 1F

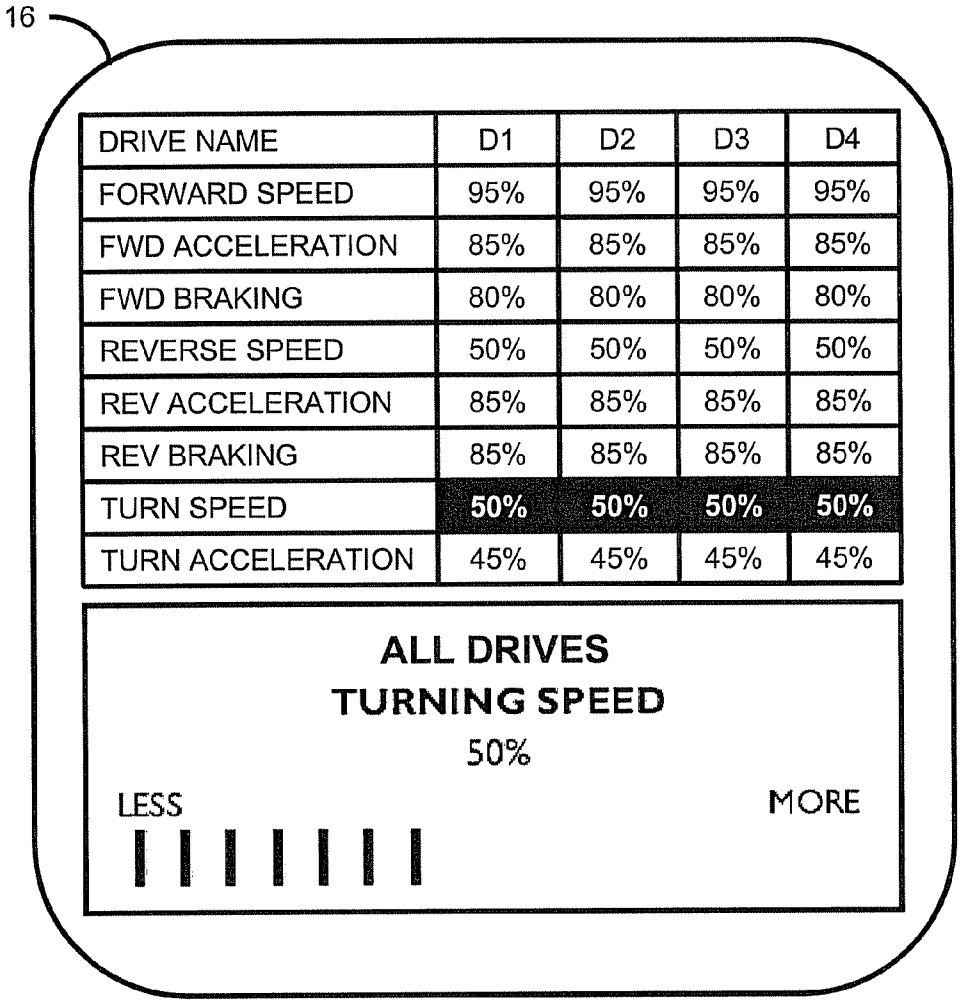
16
DRIVE NAME
D1
D2
D3
D4
FORWARD SPEED
95%
95%
95%
95%
FWD ACCELERATION
85%
85%
85%
85%
FWD BRAKING
80%
80%
80%
80%
REVERSE SPEED
50%
50%
50%
50%
REV ACCELERATION
85%
85%
85%
85%
REV BRAKING
85%
85%
85%
85%
TURN SPEED
50%
50%
50%
50%
TURN ACCELERATION
45%
45%
45%
45%
ALL DRIVES
TURNING SPEED
50%
LESS
MORE

Fig. 1G

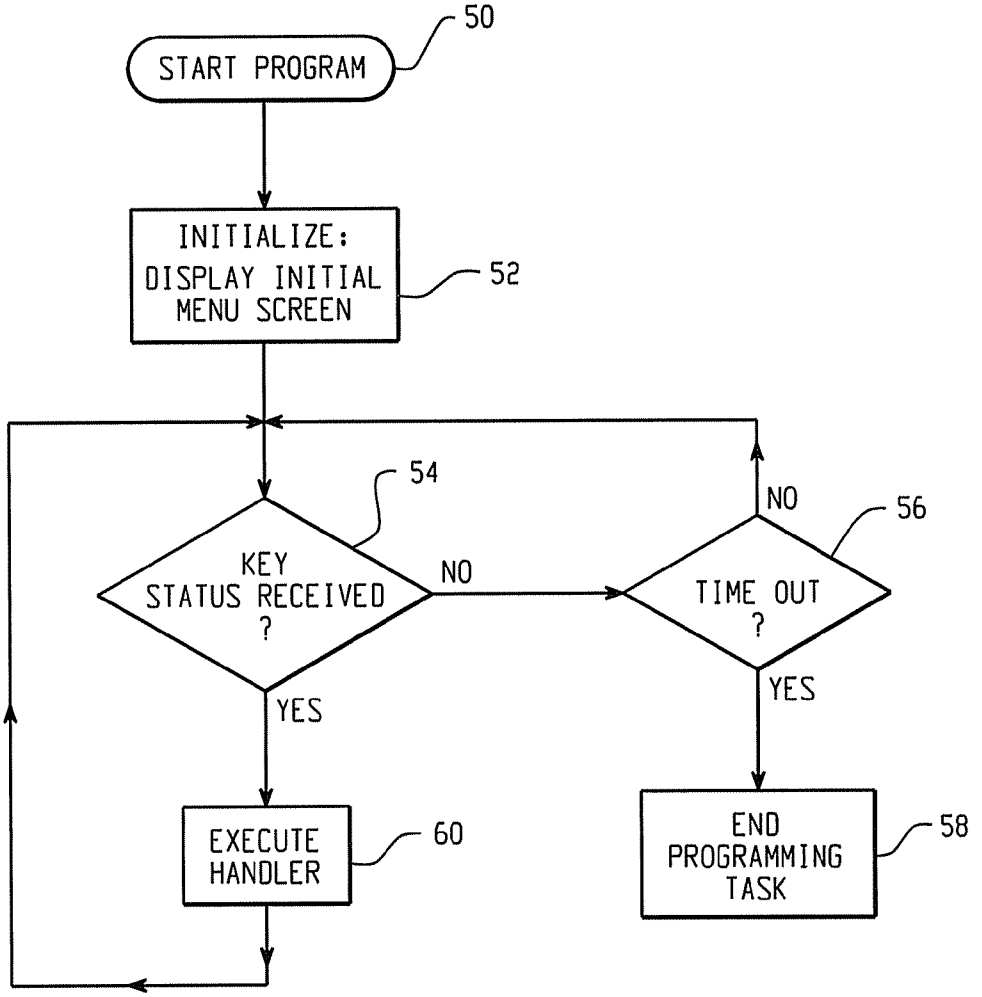
START PROGRAM
50
INITIALIZE:
DISPLAY INITIAL
MENU SCREEN
52
54
KEY
STATUS RECEIVED
?
NO
56
TIME OUT
?
NO
YES
YES
EXECUTE
HANDLER
60
END
PROGRAMMING
TASK
58

Fig. 2

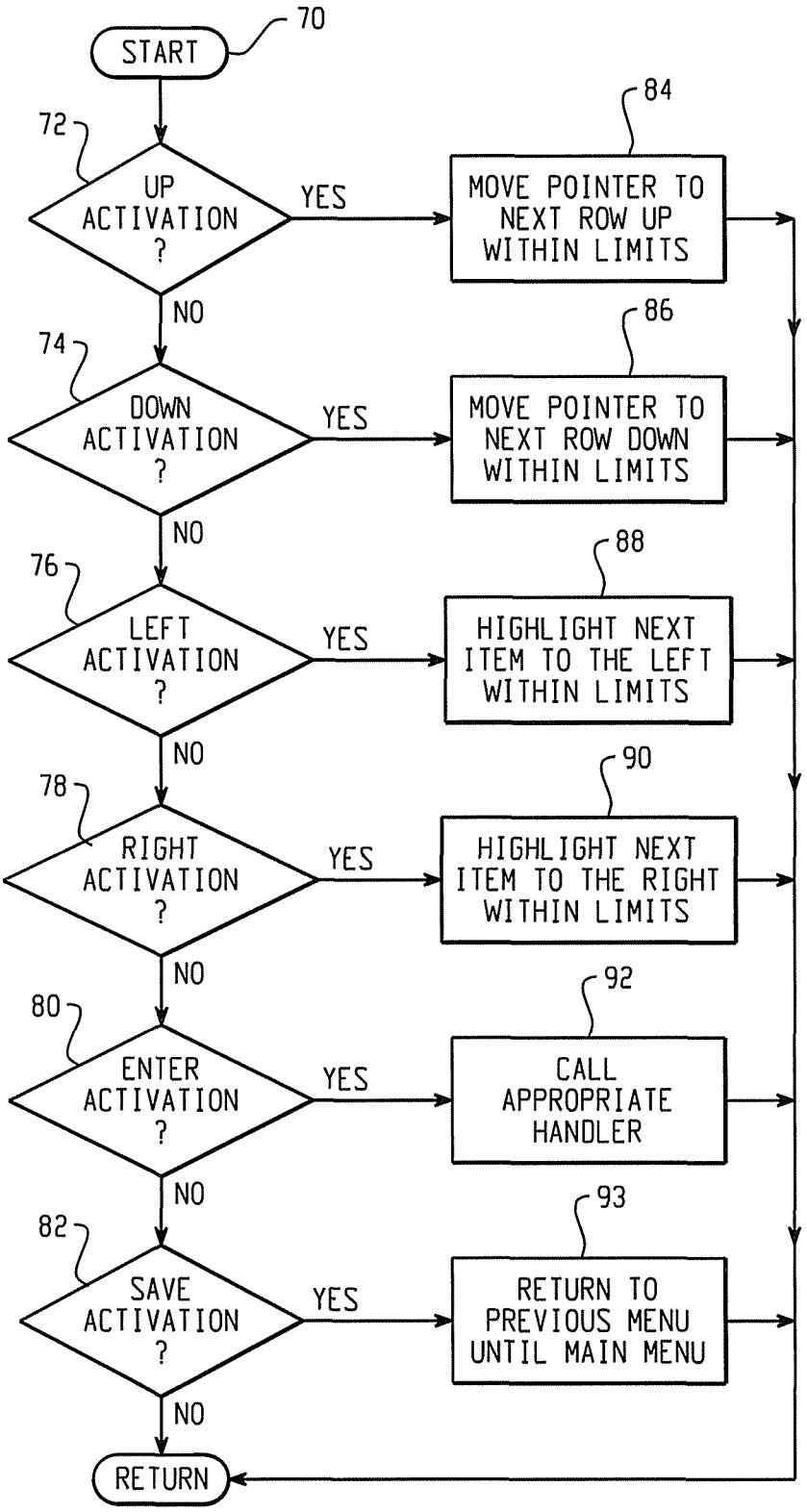
START
70
72
UP ACTIVATION ?
YES
84
MOVE POINTER TO NEXT ROW UP WITHIN LIMITS
NO
74
DOWN ACTIVATION ?
YES
86
MOVE POINTER TO NEXT ROW DOWN WITHIN LIMITS
NO
76
LEFT ACTIVATION ?
YES
88
HIGHLIGHT NEXT ITEM TO THE LEFT WITHIN LIMITS
NO
78
RIGHT ACTIVATION ?
YES
90
HIGHLIGHT NEXT ITEM TO THE RIGHT WITHIN LIMITS
NO
80
ENTER ACTIVATION ?
YES
92
CALL APPROPRIATE HANDLER
NO
82
SAVE ACTIVATION ?
YES
93
RETURN TO PREVIOUS MENU UNTIL MAIN MENU
NO
RETURN

Fig. 3

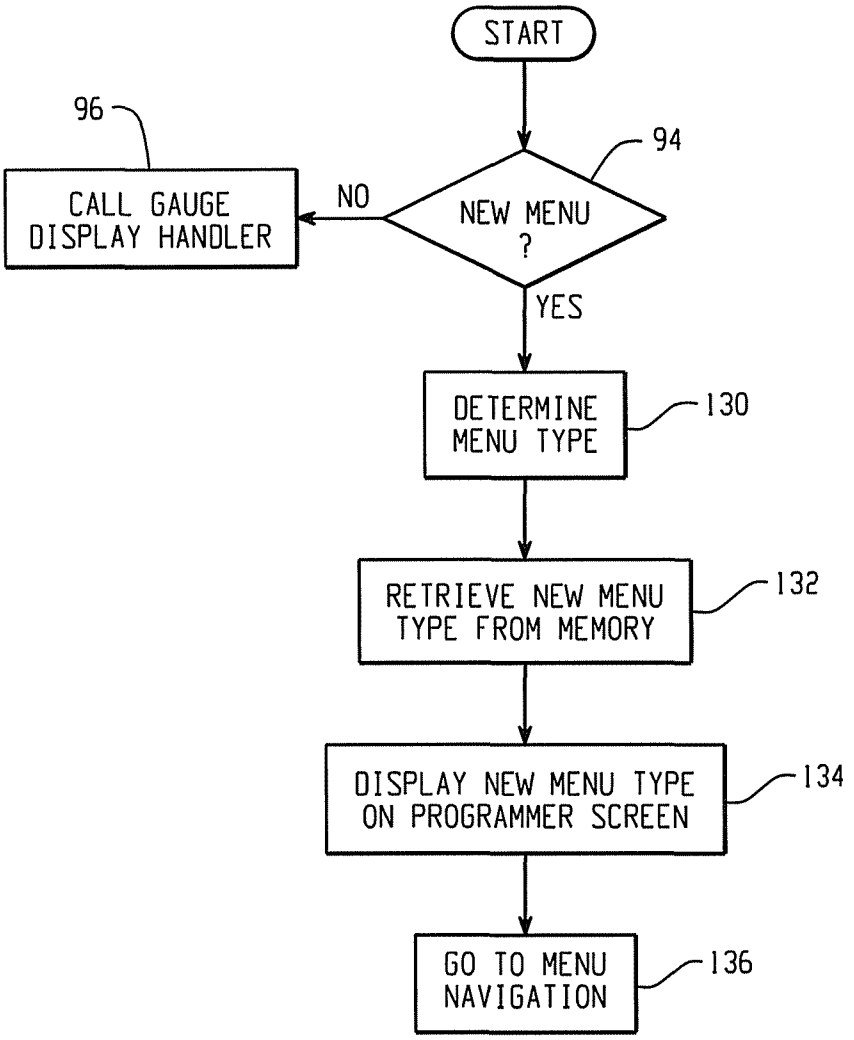
START
96
94
CALL GAUGE DISPLAY HANDLER
NO
NEW MENU ?
YES
DETERMINE MENU TYPE
130
RETRIEVE NEW MENU TYPE FROM MEMORY
132
DISPLAY NEW MENU TYPE ON PROGRAMMER SCREEN
134
GO TO MENU NAVIGATION
136

Fig. 4

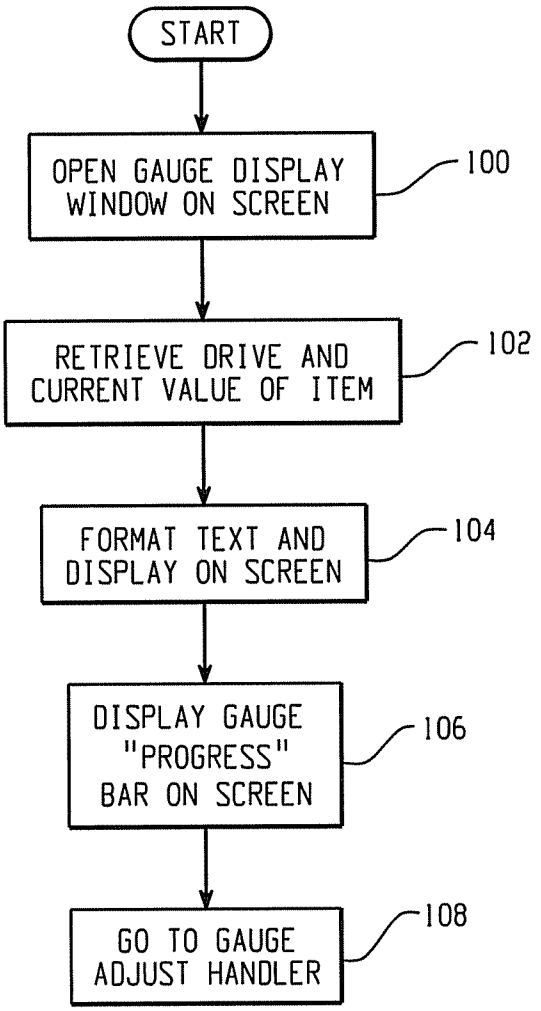
START
OPEN GAUGE DISPLAY WINDOW ON SCREEN
100
RETRIEVE DRIVE AND CURRENT VALUE OF ITEM
102
FORMAT TEXT AND DISPLAY ON SCREEN
104
DISPLAY GAUGE "PROGRESS" BAR ON SCREEN
106
GO TO GAUGE ADJUST HANDLER
108

Fig. 5

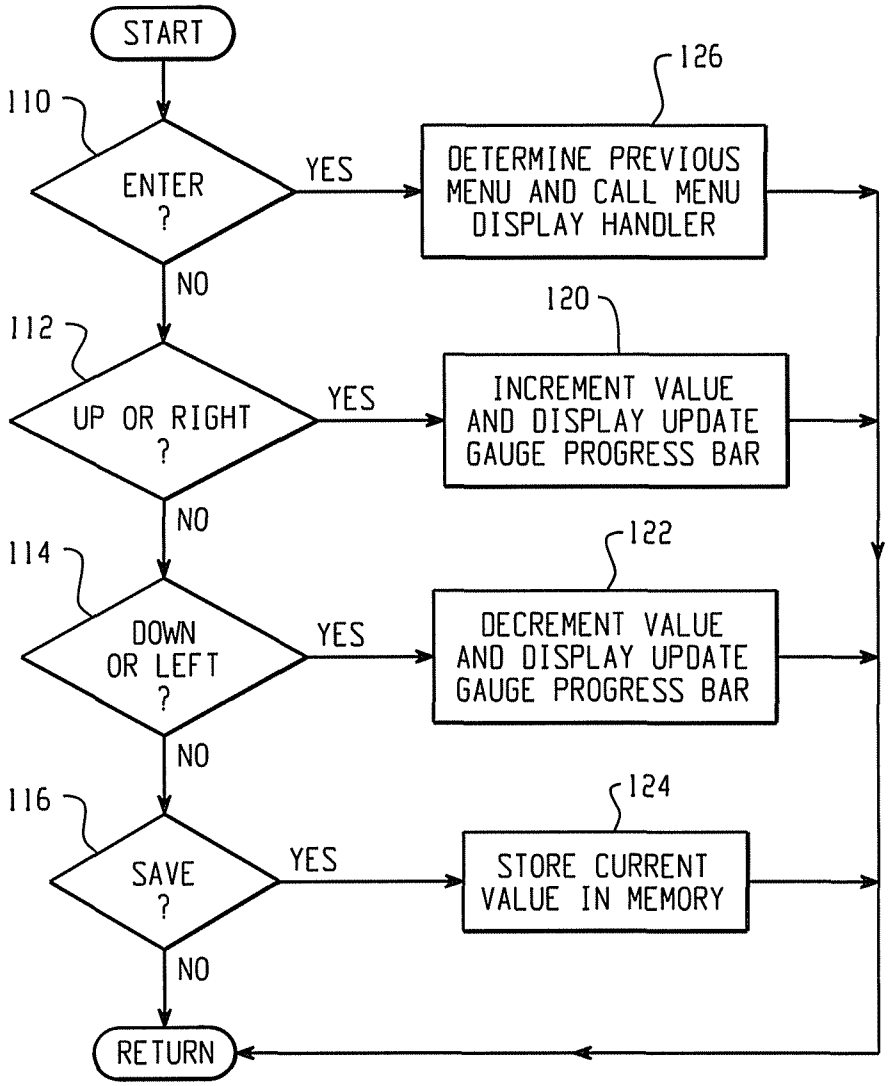
START
110
ENTER ?
YES
126
DETERMINE PREVIOUS MENU AND CALL MENU DISPLAY HANDLER
NO
112
UP OR RIGHT ?
YES
120
INCREMENT VALUE AND DISPLAY UPDATE GAUGE PROGRESS BAR
NO
114
DOWN OR LEFT ?
YES
122
DECREMENT VALUE AND DISPLAY UPDATE GAUGE PROGRESS BAR
NO
116
SAVE ?
YES
124
STORE CURRENT VALUE IN MEMORY
NO
RETURN

Fig. 6

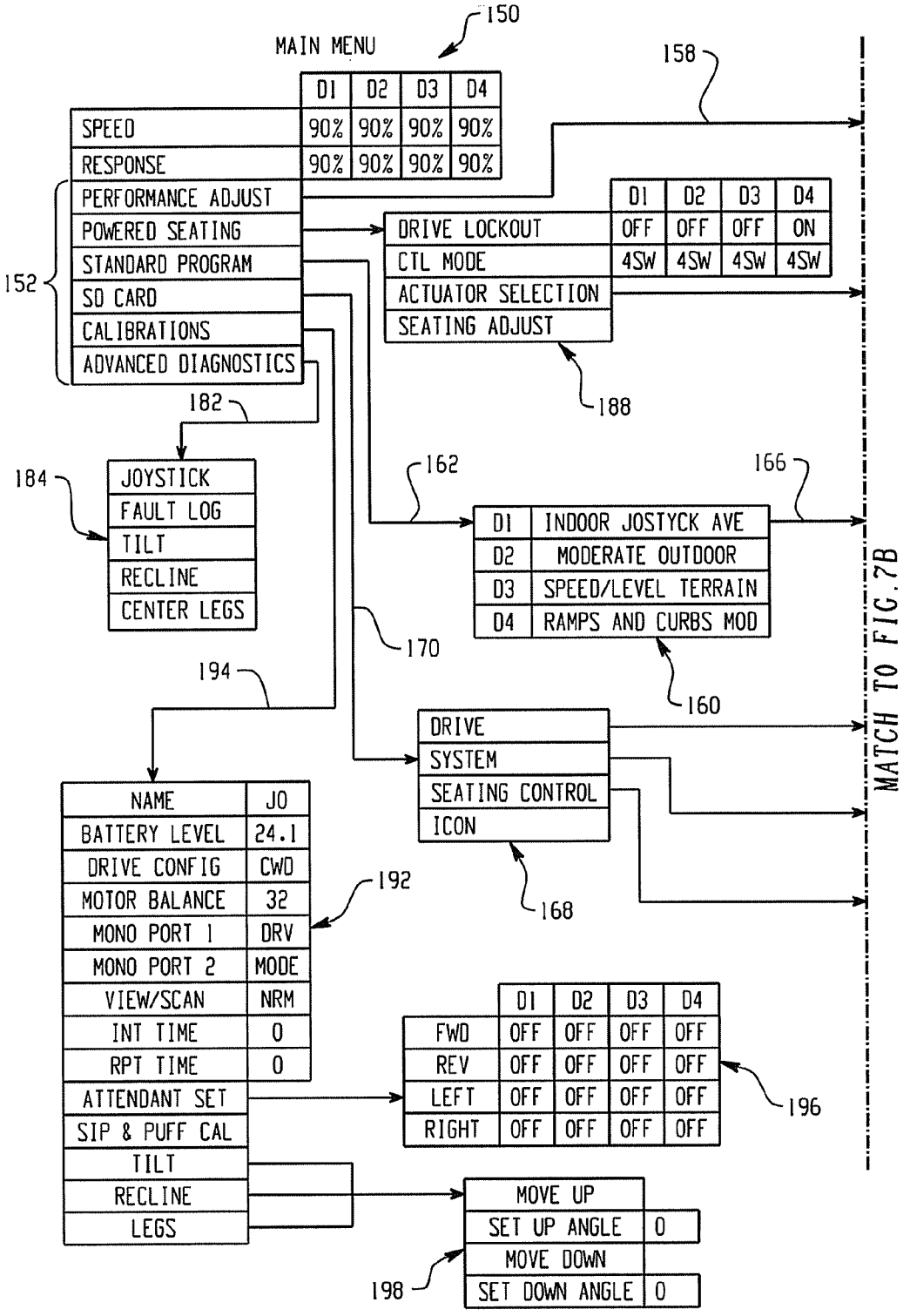
150
MAIN MENU
D1 D2 D3 D4
SPEED 90% 90% 90% 90%
RESPONSE 90% 90% 90% 90%
PERFORMANCE ADJUST
POWERED SEATING
STANDARD PROGRAM
SD CARD
CALIBRATIONS
ADVANCED DIAGNOSTICS
152
158
D1 D2 D3 D4
DRIVE LOCKOUT OFF OFF OFF ON
CTL MODE 4SW 4SW 4SW 4SW
ACTUATOR SELECTION
SEATING ADJUST
188
182
184
JOYSTICK
FAULT LOG
TILT
RECLINE
CENTER LEGS
162
166
D1 INDOOR JOSTYCK AVE
D2 MODERATE OUTDOOR
D3 SPEED/LEVEL TERRAIN
D4 RAMPS AND CURBS MOD
160
170
194
DRIVE
SYSTEM
SEATING CONTROL
ICON
168
NAME JO
BATTERY LEVEL 24.1
DRIVE CONFIG CWD
MOTOR BALANCE 32
MONO PORT 1 DRV
MONO PORT 2 MODE
VIEW/SCAN NRM
INT TIME 0
RPT TIME 0
192
ATTENDANT SET
SIP & PUFF CAL
TILT
RECLINE
LEGS
D1 D2 D3 D4
FWD OFF OFF OFF OFF
REV OFF OFF OFF OFF
LEFT OFF OFF OFF OFF
RIGHT OFF OFF OFF OFF
196
MOVE UP
SET UP ANGLE 0
MOVE DOWN
SET DOWN ANGLE 0
198
MATCH TO FIG.7B

Fig. 7A

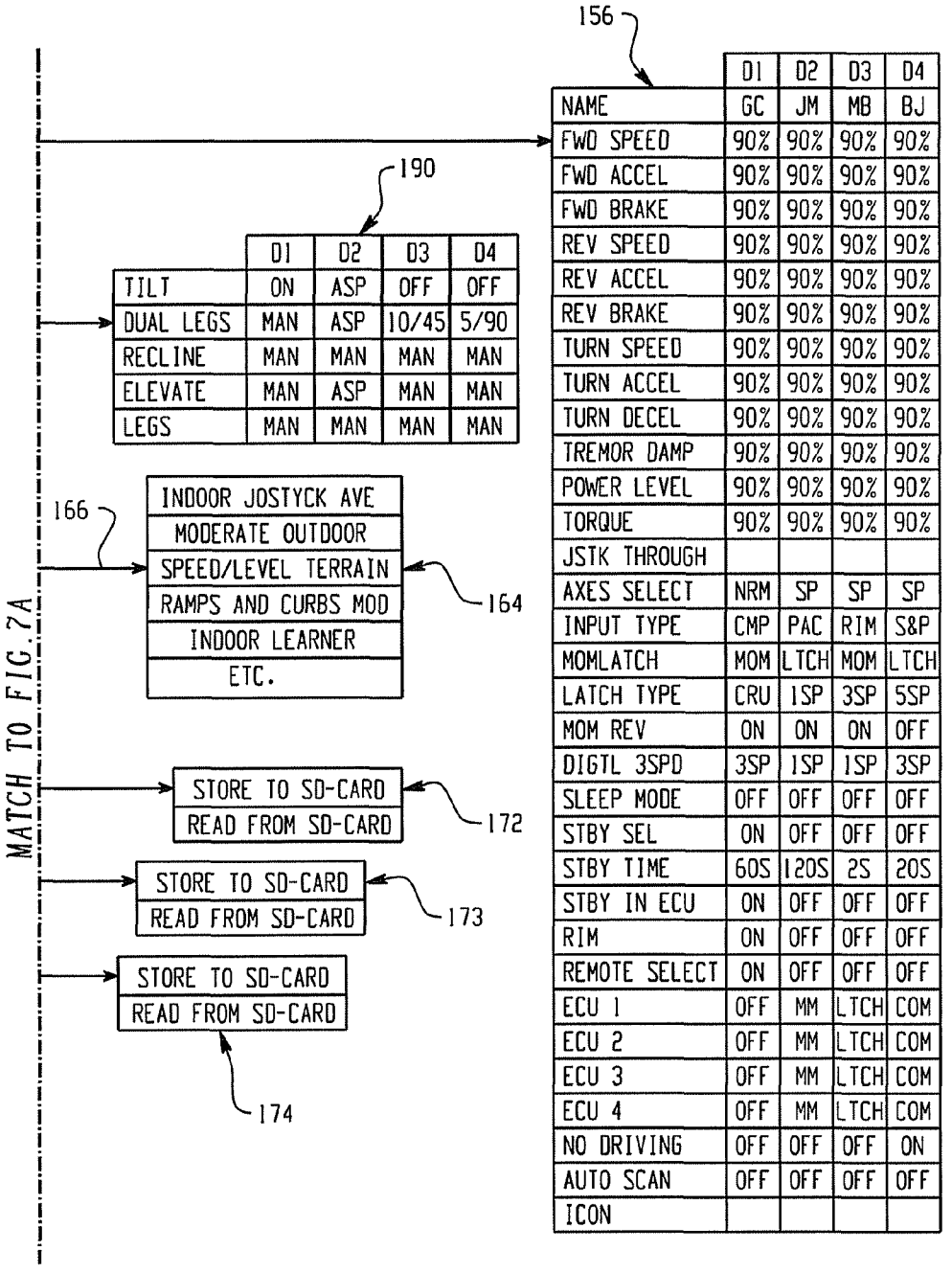
156
D1 D2 D3 D4
NAME GC JM MB BJ
FWD SPEED 90% 90% 90% 90%
FWD ACCEL 90% 90% 90% 90%
FWD BRAKE 90% 90% 90% 90%
REV SPEED 90% 90% 90% 90%
REV ACCEL 90% 90% 90% 90%
REV BRAKE 90% 90% 90% 90%
TURN SPEED 90% 90% 90% 90%
TURN ACCEL 90% 90% 90% 90%
TURN DECEL 90% 90% 90% 90%
TREMOR DAMP 90% 90% 90% 90%
POWER LEVEL 90% 90% 90% 90%
TORQUE 90% 90% 90% 90%
JSTK THROUGH
AXES SELECT NRM SP SP SP
INPUT TYPE CMP PAC RIM S&P
MOMLATCH MOM LTCH MOM LTCH
LATCH TYPE CRU 1SP 3SP 5SP
MOM REV ON ON ON OFF
DIGTL 3SPD 3SP 1SP 1SP 3SP
SLEEP MODE OFF OFF OFF OFF
STBY SEL ON OFF OFF OFF
STBY TIME 60S 120S 2S 20S
STBY IN ECU ON OFF OFF OFF
RIM ON OFF OFF OFF
REMOTE SELECT ON OFF OFF OFF
ECU 1 OFF MM LTCH COM
ECU 2 OFF MM LTCH COM
ECU 3 OFF MM LTCH COM
ECU 4 OFF MM LTCH COM
NO DRIVING OFF OFF OFF ON
AUTO SCAN OFF OFF OFF OFF
ICON
190
D1 D2 D3 D4
TILT ON ASP OFF OFF
DUAL LEGS MAN ASP 10/45 5/90
RECLINE MAN MAN MAN MAN
ELEVATE MAN ASP MAN MAN
LEGS MAN MAN MAN MAN
166
INDOOR JOSTYCK AVE
MODERATE OUTDOOR
SPEED/LEVEL TERRAIN
RAMPS AND CURBS MOD
INDOOR LEARNER
ETC.
164
STORE TO SD-CARD
READ FROM SD-CARD
172
STORE TO SD-CARD
READ FROM SD-CARD
173
STORE TO SD-CARD
READ FROM SD-CARD
174
MATCH TO FIG.7A

Fig. 7B

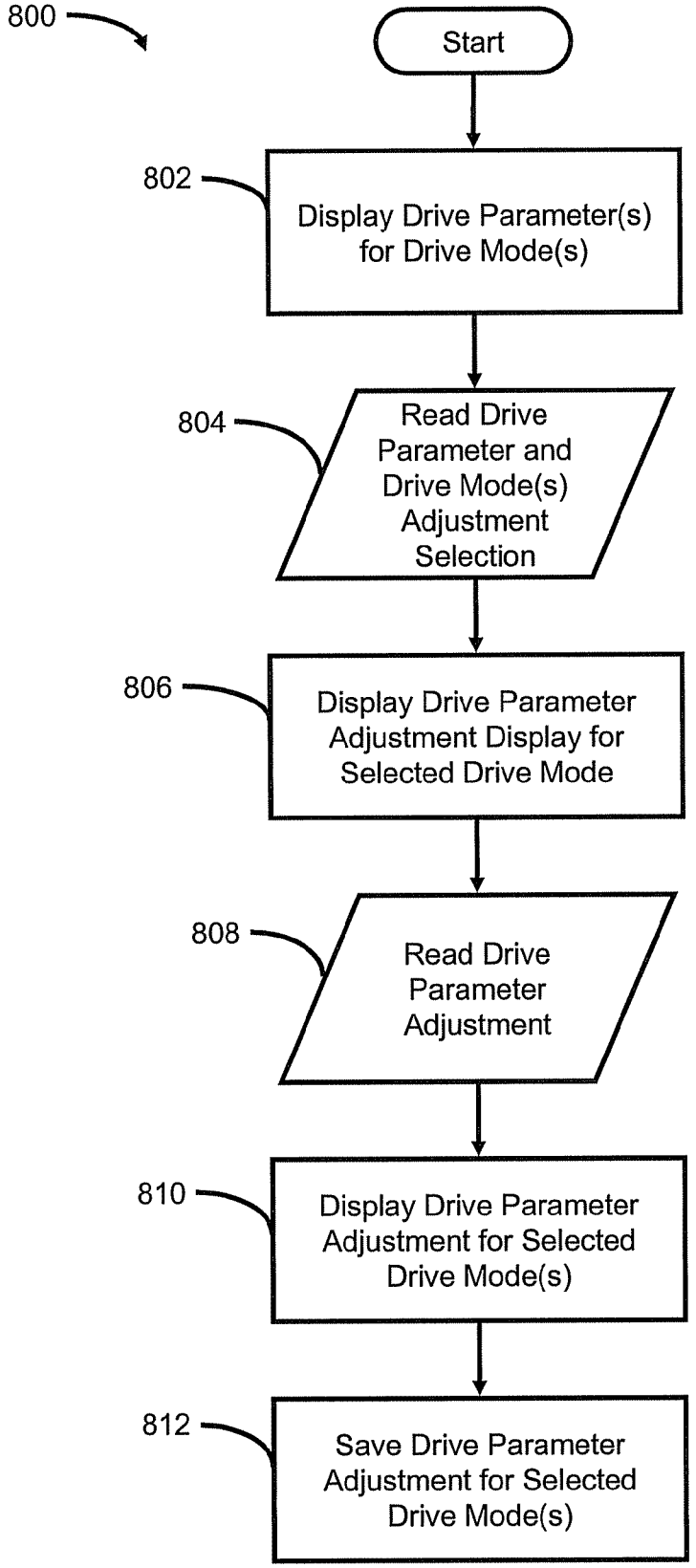
800
Start
802
Display Drive Parameter(s) for Drive Mode(s)
804
Read Drive Parameter and Drive Mode(s) Adjustment Selection
806
Display Drive Parameter Adjustment Display for Selected Drive Mode
808
Read Drive Parameter Adjustment
810
Display Drive Parameter Adjustment for Selected Drive Mode(s)
812
Save Drive Parameter Adjustment for Selected Drive Mode(s)

Fig. 8

METHOD AND APPARATUS FOR PROGRAMMING PARAMETERS OF A POWER DRIVEN WHEELCHAIR FOR A PLURALITY OF DRIVE SETTINGS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. Ser. No. 12/064,697, filed Feb. 25, 2008, titled METHOD AND APPARATUS FOR PROGRAMMING PARAMETERS OF A POWER DRIVEN WHEELCHAIR FOR A PLURALITY OF DRIVE SETTINGS, which claims priority to International Application Serial No. PCT/US2006/033963, filed Aug. 31, 2006, which claims the benefit of eight U.S. provisional patent applications, including Ser. No. 60/712,987, filed Aug. 31, 2005, Ser. No. 60/727,005, filed Oct. 15, 2005, Ser. No. 60/726,983, filed Oct. 15, 2005, Ser. No. 60/726,666, filed Oct. 15, 2005, Ser. No. 60/726,981, filed Oct. 15, 2005, Ser. No. 60/726,993, filed Oct. 15, 2005, Ser. No. 60/727,249, filed Oct. 15, 2005, and Ser. No. 60/727,250, filed Oct. 15, 2005. This application is also related to seven co-pending U.S. utility patent applications filed the same day as this application, including 60/727,005 entitled "Mode Programmable Actuator Controller for Power Positioning Seat or Leg Support of a Wheelchair," 60/726,983 entitled "Method and Apparatus for Setting or Modifying Programmable Parameters in Power Driven Wheelchair," 60/726,981 entitled "Method and Apparatus for Programming Parameters of a Power Driven Wheelchair for a Plurality of Drive Settings," 60/726,993 entitled "Adjustable Mount for Controller of Power Driven Wheelchair," 60/727,249 entitled "Method and Apparatus for Automated Positioning of User Support Surfaces in Power Driven Wheelchair," 60/726,666 entitled "Context-Sensitive Help for Display Device Associated with a Power Driven Wheelchair," and 60/727,250 entitled "Power Driven Wheelchair." The contents of all above-identified patent application(s) and patent(s) are fully incorporated herein by reference.

BACKGROUND

The present invention is directed to power driven wheelchairs, in general, and, more particularly, a method and apparatus for programming parameters of a power driven wheelchair for a plurality of drive settings using a common menu image of an interactive display screen.

Power driven wheelchairs, which may be of the type manufactured by Invacare Corporation of Elyria, Ohio, for example, are generally controlled by an electronic control system. An exemplary control system for power or motor driven wheelchairs is disclosed in U.S. Pat. No. 6,819,981, entitled "Method and Apparatus for Setting Speed/Response Performance Parameters of a Power Driven Wheelchair", issued Nov. 16, 2004, and assigned to the same assignee as the instant application, which patent being incorporated by reference herein in its entirety.

Typically, power driven wheelchairs have a plurality of drive settings for operation of the wheelchair by the user. An exemplary wheelchair may include four drive settings which may be Drive **1** (D**1**) for indoor operation, Drive **2** (D**2**) for moderate outdoor operation, Drive **3** (D**3**) for special operation, and Drive **4** (D**4**) for ramps and curbs. For each drive setting, there are numerous performance and power seating parameters which are programmed into the control system to satisfy the operational capabilities of the individual user of the wheelchair. The programming task is normally conducted through a hand held programmer unit having an interactive display and coupled to the control system much as described in the above-referenced U.S. Pat. No. 6,819,981, for example. Currently, a set of parameters may be programmed into the control system through the interactive display of the programmer unit for only one drive setting at a time.

SUMMARY OF THE INVENTION

In accordance with one aspect of the present invention, a method of programming parameters of a power driven wheelchair for a plurality of drive modes comprises: displaying a menu image on an interactive display screen, the menu image including settings of a plurality of wheelchair parameters for a plurality of drive modes of the wheelchair; selecting a wheelchair parameter for a drive mode from the displayed menu image; and programming the setting of the selected wheelchair parameter to a desired setting.

In accordance with another aspect of the present invention, apparatus for programming parameters of a power driven wheelchair for a plurality of drive modes comprises: a display; a controller for interacting with the display and operative to display a menu image on a screen of the display, the menu image including settings of a plurality of wheelchair parameters for a plurality of drive modes of the wheelchair; and a programming unit operative to control the controller to select a wheelchair parameter for a drive mode using the displayed menu image, and to program the setting of the selected wheelchair parameter to a desired setting.

In accordance with yet another aspect of the present invention, apparatus for programming parameters of a power driven wheelchair for a plurality of drive modes comprises: a display; a memory for storing a plurality of menu images, each menu image including settings of a plurality of wheelchair parameters for a plurality of drive modes of the wheelchair; a controller for interacting with the memory and display; and a programming unit operative to control the controller to display a menu image from the plurality of stored menu images on the screen of the display according to a predetermined routing, to select a wheelchair parameter for a drive mode using the displayed menu image, and to program the setting of the selected wheelchair parameter to a desired setting.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram schematic of an exemplary embodiment for programming parameter values into a control system of a power driven wheelchair.

FIG. **1**A is an exemplary main menu image for display on an interactive display screen.

FIG. **1**B is one example of a gauge display window for display on an interactive display screen.

FIG. **1**C is another example of a gauge display window for display on an interactive display screen.

FIG. **1**D is an example of a display showing a menu window displaying drive parameters for a plurality of drive modes and a drive parameter adjustment window for a single drive mode there below.

FIG. **1**E is an example of a display showing a menu window displaying drive parameters for a plurality of drive modes and a drive parameter adjustment window for a all drive modes there below.

FIG. **1**F is an example of a display showing a portion of a performance adjust window displaying drive parameters for a plurality of drive modes and drive parameter adjustment window for a single drive mode there below.

FIG. **1**G is an example of a display showing a portion of a performance adjust window displaying drive parameters for a plurality of drive modes and drive parameter adjustment window for all drive modes there below.

FIGS. **2** through **6** are flowcharts which exemplify programs for execution by a controller for programming parameter values of different drive modes for the control system of the wheelchair.

FIGS. **7**A and **7**B compositely depict a flowchart exemplifying menu images for display on an interactive display screen and predetermined navigational routings between menu images. FIGS. **7**A and **7**B will hereinafter be collectively referred to as FIG. **7**.

FIG. **8** is an example flowchart of a procedure for displaying one or more drive parameters for one or more drive modes and for adjusting one or more drive parameters for one or more drive modes.

DETAILED DESCRIPTION

The block diagram schematic of FIG. **1** illustrates suitable apparatus for embodying the principles of applicants' general concept. Referring to FIG. **1**, a remote, hand held programmer unit **14** may be coupled to a control system **10** of the power driven wheelchair and comprises a display screen **16** which may be a liquid crystal display (LCD), for example, and a plurality of pushbuttons **18** for use in selecting the desired drive and parameter and entering the parameter settings, like Speed and Response values, for example, by interacting with the image on the display screen **16** as will become better understood from the description below. More specifically, the pushbuttons **18** may include a Power I/O (P), Save (Sa), Enter (E), left arrow, right arrow, up arrow and down arrow pushbuttons.

In the present exemplary embodiment, the remote programmer unit **14** communicates with a main controller **20** of the control system **10** via serially coded signals over lines **22**. The main controller **20** may include a programmed microcontroller, which may be of the type manufactured by Infineon, bearing model no. SAF-XC-164CS, for example. The serial lines **22** may be coupled to the microcontroller **20** through a serial communication controller (SCC) **24** which may be of the type licensed by Echelon Corporation and manufactured by Toshiba bearing model no. TMPN3150, for example. The tasks of the Echelon controller **24** include setting the protocol, performing serial/parallel translations, checking for errors in transmission, and managing the traffic for the serial communication between the remote programmer unit **14** and microcontroller **20**. In the alternative, the tasks of the serial communication controller **24** may be programmed into the main controller **20**, in which case, the serial lines **22** may be coupled directly to the main controller **20** and the SCC may be eliminated. Moreover, while the communication link between the programmer unit **14** and controller **20** of the exemplary embodiment is over lines **22**, it may just as well be a wireless communication link, like a BLUETOOTH link or a 802.11 link, for example, without deviating from the broad principles of applicants' general concept.

The microcontroller **20** may include an internal memory **28** which may be of the random access (RAM) or scratch pad type, for example, and is coupled to an electrically erasable programmable read only memory (EEPROM) **32** over address (A), data (D) and control (C) lines. While the memory **28** is shown internal to the microcontroller **20**, it is understood that a portion or all of the memory **28** may be just as well external to the microcontroller **20**. Generally, when powered up, the controller **20** will boot up under program control and may access the preset parameters and relationships stored in the EEPROM **32** and store them temporarily to the scratch pad memory **28** for interaction with the remote programmer unit **14** and operation of the wheelchair. It is understood that when power is removed, the stored data of the RAM **28** will be lost. Only, the EEPROM **32** will retain the data of its memory without power.

As indicated above, the microcontroller **20** of the power wheelchair is programmed to interact with the remote programmer unit **14** via signal lines **22** and communication controller **24**, if used, for entry of the parameter values or settings and for the display thereof. The flowcharts of FIGS. **2** through **6** exemplify programs for execution by the microcontroller **20** for performing the aforementioned tasks. In describing the various flowcharts herein below, the term block will be used to refer to a step or steps for performing a function or task by the controller **20**.

Referring to FIG. **2**, in block **50**, the microcontroller **20** responds to the activation (depression) of the P pushbutton of the remote programmer unit **14** by entering the programming task program or parameter setting mode. In the next block **52**, the microcontroller **20** initializes the program settings of the parameter setting mode, and then, transmits via lines **22** an initial screen of a main menu image to the programmer unit **14** for display on the LCD screen **16** thereof. The display screen **16** of the programmer unit **14** may be a graphics LCD screen having 160×160 pixels for display, for example.

An exemplary initial or main menu image screen display in a table format is shown in FIG. **1**A. In the present embodiment, the main menu screen image is a table with three rows. The top row of the three includes the parameter word "Speed" in the left most column followed by four columns of the preset parameter values thereof for the drives D**1**-D**4** and the next row down includes the parameter word "Response" in the left most column followed the four columns of the preset parameter values thereof for the drives D**1**-D**4**, all of the parameter values being accessed from the EEPROM **32** as described herein above. Note that the Speed and Response parameters may be programmed for all of the drives: D**1**, D**2**, D**3** and D**4** which are displayed in the table format of the main menu screen image. The bottom row of the table may include the text "Advanced Menu" to permit access to a selection menu screen for selection of additional menu screen images for more parameter settings, or, in the alternative, additional rows of the table may be displayed for the direct selection of the additional menu screen images as will become better understood from the description of FIG. **7** infra.

The selection of each row of text may be performed by the movement of a pointer, e.g. an arrow pointer shown to the left of the image (shown to the left of "Speed" in FIG. **1**A) or by highlighting the text in some manner or both. Each row position of the pointer is correlated in the microcontroller program with a number. For example, the number 0 may represent the first row or Speed pointer position, the number 1 may represent the second row or Response pointer position, and the number 2 may represent the third row or Advanced Menu pointer position. If the pointer was set to 0 in block **52**, for example, a pointer image may appear adjacent to the text "SPEED" in row **1** as shown in FIG. **1**A, or the text "SPEED" may be highlighted.

In the present exemplary embodiment, the programmer unit **14** will send a key status signal via lines **22** to the microcontroller **20** every ten (10) milliseconds. Each key status signal will indicate to the program if a pushbutton has been depressed and a code representative of the depressed pushbutton. The program will detect the reception of a key status signal in block **54**. If the controller **20** does not receive a key

status signal within a preset period of time from the last reception (time out) as determined by block **56**, it will presume the programmer has been turned off or has been unplugged from the controller **20** and will end the programming task in block **58**.

When the program detects the reception of a key status signal in block **54**, it calls for the execution of a menu navigation handler program in block **60**. An exemplary menu navigation handler program suitable for use in the present embodiment is shown in the flowchart of FIG. **3**. Referring to FIG. **3**, the handler program starts at block **70** wherein certain initialization may be performed, Thereafter, the program sequences through a number of decisional blocks **72**, **74**, **76**, **78**, **80** and **82** to decode the key status signal to determine which menu navigation action has been requested by the programmer unit **14**. If the UP arrow key is activated, program execution will be diverted from block **72** to block **84** wherein the controller **20** will send instruction signals to the programmer unit **14** to move the pointer of the menu display image to the next row up. If the pointer is currently at its upper limit, either no action will take place or the pointer will circulate back to the lowest row. In the example menu image of FIG. **1**A, if the UP arrow key is activated, the pointer will either remain pointing to the Speed parameter row or be circulated back to the Advanced Menu row. After the controller **20** transmits the instructions in block **84**, it will return program flow back to block **54** of the flowchart of FIG. **2** awaiting the next key status signal.

Likewise, if the DOWN arrow key is activated, program execution will be diverted from block **74** to block **86** wherein the controller **20** will send instruction signals to the programmer unit **14** to move the pointer of the menu display image to the next row down. If the pointer is currently at its lower limit, either no action will take place or the pointer will circulate back to the highest row. In the example menu image of FIG. **1**A, if the DOWN arrow key is activated, the pointer will be positioned down to the Response parameter row. After the controller **20** transmits the instructions in block **86**, it will return program flow back to block **54** of the flowchart of FIG. **2** awaiting the next key status signal.

Once the desired parameter row is activated, the user may select the drive parameter value by depressing or activating the left or right keys on the programmer unit **14**. If the left arrow key is activated, program execution will be diverted from block **76** to block **88** wherein the controller **20** will send instruction signals to the programmer unit **14** to highlight the next drive parameter value to the left of the current highlighted drive parameter value. In the example of FIG. **1**A, if the Speed value at D**2** is currently highlighted, then, if the left arrow key is activated, the Speed value at D**1** will be highlighted and so on. If the Speed value at D**1** is highlighted when the left arrow key is activated, then either no action will be taken or the highlighting may be circulated to the right-most Speed value at D**4**.

Likewise, if the right arrow key is activated, program execution will be diverted from block **78** to block **90** wherein the controller **20** will send instruction signals to the programmer unit **14** to highlight the next drive parameter value to the right of the current highlighted drive parameter value. In the example of FIG. **1**A, if the Speed value at D**1** is currently highlighted, then, if the right arrow key is activated, the Speed value at D**2** will be highlighted. If the Speed value at D**4** is highlighted when the right arrow key is activated, then either no action will be taken or the highlighting may be circulated to the left-most Speed value at D**1**. After the controller **20** transmits the instructions in either block **88** or block **90**, it will return program flow back to block **54** of the flowchart of FIG. **2** awaiting the next key status signal.

Once the proper row and/or column drive parameter value is selected, by highlighting or otherwise, the user may adjust the selected drive parameter to a new value or move to another menu screen image by activating the enter (E) key on the programmer unit. When the E key is activated, program execution is diverted from block **80** to block **92** wherein the appropriate handler program is called and executed by the controller **20**. An exemplary handler program for performing the tasks of block **92** is shown by the flowchart of FIG. **4**. Referring to FIG. **4**, the handler program starts at decisional block **94** wherein it is determined if the request is for a new menu image or for parameter value adjustment. Suppose that in the example of FIG. **1**A the pointer was pointing to the row "Advanced Menu" when the E key was activated, then program execution will continue through blocks or steps to display a new menu image on the programmer display **16** which will be discussed in greater detail herein below. Otherwise, the program will divert program flow from decisional block **94** to block **96** wherein a gauge display handler program is called and executed for the adjustment of the desired parameter value.

An exemplary gauge display handler program is shown in the flowchart of FIG. **5**. Referring to FIG. **5**, the program starts at block **100** wherein the controller **20** transmits instructions to the programmer unit **14** via lines **22** to open a gauge display window in the screen **16**. Examples of gauge display windows are shown in FIGS. **1**B and **1**C. Next, in block **102**, the program retrieves the drive and current values of the desired item or parameter from memory. In block **104**, the program formats the text of the selected drive and parameter and sends instructions and data to the programmer unit **14** to display the formatted text and current drive and parameter values in the gauge display window. In the example of FIG. **1**B, the Speed parameter for drive **1** is selected and the current value is 35%, and in the example of FIG. **1**C, the Response parameter for drive **3** is selected and the current value is 70%.

Next, in block **106**, the program sends instructions and data for a "progress" bar to be displayed on the screen **16**, preferably in the lower portion of the gauge display window. Each progress bar display image may include the text "LESS" and "MORE" at the far left and right, respectively, thereof as shown in the examples of FIGS. **1**B and **1**C. In between the text, there may be displayed a row of blocks with each block representing an incremental percentage of the displayed parameter value. Accordingly, as the parameter value is increased, additional blocks will appear along the row of the progress bar consistent with the increase in value. Likewise, as the parameter value is decreased, blocks will disappear along the row of the progress bar consistent with the decrease in value. So, the progress bar appears as a thermometer for the value of the adjusted parameter.

Once the proper gauge window is fully formatted and displayed on the screen **16**, the user is ready to adjust or program the value of the selected parameter. To accomplish this task, program execution is directed to a gauge adjustment handler program in block **108**. An exemplary gauge adjust handler program is shown in the flowchart of FIG. **6** and is executed in conjunction with the program of FIG. **2**.

Referring to FIGS. **2** and **6**, the gauge adjust handler program goes through a number of decisional blocks **110**, **112**, **114** and **116** to decode the key status signal received at block **54**. So long as no keys of the programmer unit **14** are activated by the user, program execution will pass through decisional blocks **110**, **112**, **114** and **116** and be returned to block **54** for the next key status signal. With each reception of a key status

signal, program execution is directed back to the gauge adjust handler program by the block or step **60** which has knowledge that the program is in a parameter adjust mode. When an up or right arrow key is activated, program execution is directed from block **112** to block **120** wherein the parameter value is incremented a predetermined amount, the new value is displayed numerically and the gauge progress bar is updated. Likewise, when a down or left arrow key is activated, program execution is directed from block **114** to block **122** wherein the parameter value is decremented a predetermined amount, the new value is displayed numerically and the gauge progress bar display is updated. This may be visualized by the examples of FIGS. **1**B and **1**C.

Once the selected drive parameter has been adjusted to the desired value using the interactive gauge window (see FIGS. **1**B and **1**C), then the user may activate the Save key which causes the program to direct execution from block **116** to **124** wherein the program stores the new value of the selected drive parameter in a designated memory location. Then, the current menu screen may be updated with the new drive parameter value and the gauge display window may be closed. If another drive parameter of the currently displayed menu table is to be adjusted, then the foregoing described process is repeated. The process may be repeated for all drive parameters on the displayed menu table desired to be adjusted. Thus, a plurality of drive parameters displayed in a common menu image may be adjusted to desired values by navigation through the common menu image without having to change from one menu image to another.

After all of the selected drive parameters of the displayed common menu table have been adjusted to the desired values, the user may activate the Enter key, for example, which causes the program to direct execution in the program of FIG. **6** from block **110** to block **126** wherein the program determines the common menu that is displayed on screen **16** for drive parameter adjustment and directs execution to the menu display handler exemplified by the flowchart of FIG. **4**.

Referring back to FIG. **4**, in block **94** the program determines whether the request is for display of a menu image or a gauge window image. When the routine of FIG. **4** is called by block **126** as noted above, the request is for a menu image display. Therefore, program execution is directed from block **94** to block **130**. In the present example, if the current menu image on screen **16** is the main menu exemplified by FIG. **1**A, then, in block **130**, the program retains display of the main menu. Otherwise, in block **130**, the program determines the menu type or image to be displayed according to a predetermined routing which will be explained in more detail herein below. The image data of the desired menu according to the routing is retrieved from memory by block **132** and transmitted to the programmer unit **14** via lines **22** with instructions to display the menu image on screen **16** by block **134**. Thereafter, the program directs program execution to the menu navigation flowchart of FIG. **3** by block **136**.

It is understood that the main menu is not the only menu image for display on the screen **16** for performing the task of programming. In the present embodiment, there is a multiplicity of menu images of drive parameters which may be displayed on screen **16** according to a predetermined routing or order. The flowchart of FIG. **7** exemplifies a multiplicity of menu image screen displays and the predetermined routings between display images which are designated by arrowed lines. All of the menu image examples of FIG. **7** are depicted in a table format, but it is understood that other formats may be used just as well. In the example of FIG. **7**, a main menu image **150** includes Speed and Response rows as noted above in connection with the description of FIG. **1**A, but the Advanced Menu row of the menu image of FIG. **1**A may be replaced in the main menu **150** with additional rows **152** from which selections may be made for routings to other menus using the menu navigation program as described above in connection with FIG. **3**. By keying the enter button (E) as described herein above, program execution is directed to the flowchart of FIG. **4** to display the selected menu image on the screen **16**. In the present example, the additional rows **152** include: Performance Adjust, Powered Seating, Standard Program, SD Card, Calibrations, and Advanced Diagnostics.

Once the main menu image **150** is displayed on screen **16**, the user may select any row of rows **152** to display another menu image defined by the predetermined routing illustrated by the arrowed lines. For example, if the user selects the Performance Adjust row and hits enter, then a table of performance parameters **156** will be displayed on screen **16** according to the routing **158**. The exemplary table **156** may include all of the performance parameter values for all of the drives D**1**-D**4** of the powered wheelchair. It is understood that the display screen **16** may be limited to display only a window of a predetermined number of contiguous rows of table **156**, like 6 or 7 rows, for example, at a time. But, the user may scroll the window image up or down using the up or down keys of the programmer unit **14** to view, and thus, select and program or adjust additional drive parameter values as described herein above. Also, in the present embodiment, not all of the performance parameter settings are numerical, rather some may be switched between ON and OFF, and normal (NRM) and special (SP), for example.

In the present embodiment, the user may select any of the additional menu images from the additional rows **152** of the main menu image **150** on screen **16**. For example, if the user selects the Standard Programs row, a drive menu image **160** will be displayed on screen **16** according to routing **162** and from the menu image **160**, if the user selects the D**1** row, then an indoor joystick drive image **164** will be displayed on screen **16** according to routing **166**. Further, the user may select row SD Card from the main menu **150** to display menu image **168** according to routing **170**. In addition, from menu image **168**, the user may select for display additional menu images **172**, **173** and **174** for storing selected parameter settings to and reading selected parameter values from an SD Card, for example. From menu images **172**, **173** and **174** the user may select for display other possible menu images (not shown).

Further, the user may select the Advanced Diagnostics row of image **150** for display of menu image **184** according to routing **182**, for example. Still further, the user may select the Power Seating row for the display of a menu image **188** which includes a table of the drive settings for drive lockouts and control modes. The user may select an actuator selection row from menu image **188** for display of a menu image **190** from which all of the seat position actuators of the wheelchair, like tilt, dual legs, recline, elevate and legs, for example, may be programmed or adjusted for all of the drives D**1**-D**4**. Accordingly, when a drive actuator setting is selected from the menu image **188**, another menu **190** will appear on screen **16** for the selection of the desired setting. Beyond that everything else will remain substantially as described herein above.

Further yet, the user may select the Calibrations row in menu image **150** for the display of yet another menu image **192** according to routing **194** for setting additional parameters. From the menu image **192**, the user may select another menu image **196** from the Attendant Set row thereof to turn "ON" and "OFF" the parameter settings FWD, REV, LEFT and RIGHT for all of the drive modes D**1**-D**4**. A further menu

image **198** may be displayed from any of the rows Tilt, Recline or Legs on the menu image **192**.

Once in a menu image display, a user may return the display **16** to one or more previous menu images through activation of a designated pushbutton on the programmer unit **14** using the menu navigation program of FIG. **3**, for example. In the flowchart of FIG. **6** of the present embodiment, if the user activates the Enter pushbutton after programming all of the desired drive parameters of a current menu screen, program execution will divert from block **110** to block **126** wherein the program will execute the handler program of FIG. **4** for the previous menu image or type according to the predetermined routing. For example, if the menu image **156** is being displayed on screen **16**, then, if the user activates the Enter key, the display **16** will be returned to the main menu image **150** according to routing **158**. Thus, by a manipulation of the keys **18** of the programmer unit **14**, the user may navigate forward or backward among the various menu images shown in FIG. **7** for display on the screen **16** according to the designated routing thereof.

In addition, while pushbutton keys are used in the present embodiment for activating programming functions and tasks, it is understood that other implementations may be used just as well. For example, a joystick having forward, backward, right and left movements may be used in place of the pushbutton keys to perform the same or similar functions. Likewise, the programmer unit **14** of the present embodiment is described as being coupled to the controller **20** via a serial communication controller **24**, but it may be coupled to the controller **20** over a serial bus structure, like a CAN bus structure, or wirelessly without deviating from the broad principles of applicants' general concept.

Use of the exemplary methods and apparatus should be readily apparent from the discussions above. In the exemplary embodiment, a user connects the programmer unit **14** to the control system **10** of the power wheelchair, and presses the power I/O (P) button. A coded signal indicative of the P button being depressed is transmitted over lines **22** to the controller **20**. In response, the controller **20** generates appropriate menu images which are transmitted to unit **14** via lines **22** for display on the display screen thereof. Certain of the menu images include parameter values for all drive modes on a common menu screen. A user may use buttons **18** to select one of these menu images and to access, adjust, and save to memory **28**, **32** (i.e. program) parameter values of any of the drive modes from the selected single menu screen. Thereafter, the user may select other menu images via programming unit **14** for programming other drive parameters or disconnect the programming unit form the controller so that the wheelchair may be operated in conjunction with the programmed parameters.

Referring now to FIG. **1**D, a display showing a menu window displaying drive parameters for a plurality of drive modes and a drive parameter adjustment window for a single drive mode there below. Display **16** has a main menu window showing the drive parameters of "SPEED" and "RESPONSE" for drive modes D**1**-D**4**. Upon selection of the "SPEED" parameter for drive mode D**1**, a "SPEED DRIVE **1**" parameter adjustment window is displayed below the main menu window. Adjustment of the "SPEED DRIVE **1**" parameter is accomplished as described above with respect to FIG. **1**B. As shown in FIG. **1**D, adjustment of a drive parameter of one drive mode can be accomplished while the current settings of the non-selected or non-adjusted drive parameters for the drive modes remains visible.

In FIG. **1**E, the "SPEED" parameter for all drive modes has been selected. In this embodiment, a "SPEED ALL DRIVES" parameter adjustment window is displayed below the main menu window. Adjustment of the "SPEED ALL DRIVES" parameter is also accomplished as described above with respect to FIG. **1**B. As shown in FIG. **1**E, adjustment of the same drive parameter for all drive modes can be accomplished while the current settings of the non-adjusted or non-selected drive parameters for the drive modes remains visible. The "RESPONSE" drive parameter can also adjusted in the same manner as the above-described "SPEED" drive parameter.

FIG. **1**F is similar to FIG. **1**D except that the drive parameters displayed for possible adjustment are from the performance adjustment menu **156** of FIG. **7**. In this embodiment, upon selection of a performance adjustment parameter such as "TURNING SPEED" for drive D**1**, a "DRIVE D**1** TURNING SPEED" parameter adjustment window is displayed in the lower half of display **16** below the "TURNING SPEED" parameter display. Adjustment of the "DRIVE D**1** TURNING SPEED" parameter is accomplished as described above with respect to FIG. **1**B. As show in FIG. **1**F, adjustment of a performance drive parameter of one drive mode can be accomplished while the current settings of the non-selected or non-adjusted drive parameters for the drive modes remains visible.

In FIG. **1**G, the " " parameter for all drive modes has been selected. In this embodiment, an "ALL DRIVES TURNING SPEED" parameter adjustment window is displayed below the performance adjustment parameter menu window. Adjustment of the "ALL DRIVES TURNING SPEED" parameter is also accomplished as described above with respect to FIG. **1**B. As shown in FIG. **1**G, adjustment of the same drive parameter for all drive modes can be accomplished while the current settings of the non-adjusted or non-selected drive parameters for the drive modes remains visible. Any and all of the performance adjustment parameters show in **156** of FIG. **7** can adjusted the same or similar manner as the "TURNING SPEED" drive parameter.

Referring now to FIG. **8**, flowchart of one embodiment of a procedure **800** for displaying one or more drive parameters for one or more drive modes and for adjusting one or more drive parameters for one or more drive modes is shown. In block **802**, one or more drive parameters for one or more drive modes are displayed as shown, for example, in FIGS. **1**D, **1**E, **1**F, and **1**G. Such drive parameters include, for example, "SPEED," "RESPONSE," "TURN SPEED," FWD BRAKING," etc. Drive modes include "D**1**," "D**2**," . . . etc. In block **804**, a drive parameter and one or more drive modes adjustment selection is read. As described earlier, this can be accomplished, for example, by highlighting on the display which drive parameter and which drive mode or modes are desired to be adjusted. In block **806**, a drive parameter adjustment window for the selected drive mode or modes is displayed. Such windows or displays include the "SPEED DRIVE **1**" adjustment window of FIG. **1**D, "SPEED ALL DRIVES" adjustment window of FIG. **1**E, "DRIVE D**1** TURNING SPEED" adjustment window of FIG. **1**F, and "ALL DRIVES TURNING SPEED" adjustment window of FIG. **1**G. In block **808**, the drive parameter adjustment is read such as, for example, reading the gauge adjustment value from a drive parameter adjustment window. In block **810**, the adjusted drive parameter value is displayed in the drive parameter and drive mode menu. In block **812**, the adjusted drive parameter value is stored or saved to a memory such as, for example, memory **28** or EEPROM **32**.

Procedure **800** has been shown as an example flow. The rectangular elements denote "processing blocks" and represent computer software instructions or groups of instructions.

The diamond shaped elements denote "decision blocks" and represent computer software instructions or groups of instructions that affect the execution of the computer software instructions represented by the processing blocks. Alternatively, the processing and decision blocks represent steps performed by functionally equivalent circuits such as a digital signal processor circuit or an application-specific integrated circuit (ASIC). The flow diagram does not depict syntax of any particular programming language. Rather, the flow diagram illustrates the functional information one skilled in the art may use to fabricate circuits or to generate computer software to perform the processing of the system. It should be noted that many routine program elements, such as initialization of loops and variables and the use of temporary variables are not shown.

In an alternate embodiment, the programming functions of the programmer unit **14** may be integrated into the microcontroller **20** which may be contained in a multi-function joystick unit or display unit of the wheelchair. The joystick unit and the display unit will each include an interactive display screen, which may be similar to the display screen **16**, coupled to the microcontroller **20**. If a display unit is used, it may include pushbuttons similar to the pushbuttons **18** which will be used in the same manner as described for the programmer unit **14** above to interact with the menu images of the display screen. If a joystick unit is used, the positioning of the joystick may replace the pushbuttons **18** for interacting with the menu images of the display screen. Thus, either a joystick unit or a display unit of the wheelchair may be used in the alternative to perform the programming functions as described supra for programming parameter values for the different drive modes into the control system of the wheelchair.

While one or more exemplary embodiments have been provided herein, it is understood that these embodiments are presented merely for purposes of illustration and are in no way intended to be limiting to the present invention. Modifications may appear to all those skilled in the art. Accordingly, applicants' invention should not be limited in any way by such embodiments, but rather construed in breadth and broad scope in accordance with the recitation of the claims appended hereto.

What is claimed is:

1. A method for programming parameters of a power driven wheelchair, comprising:

displaying a menu image on an interactive display screen, wherein the menu image includes current settings of a plurality of wheelchair parameters for a plurality of drive modes of the wheelchair;

selecting a wheelchair parameter for a drive mode from the displayed menu image;

in response to the selecting, displaying an adjustment image on the interactive display screen to program the selected wheelchair parameter setting while continuing to display the menu image; and

programming the setting of the selected wheelchair parameter to a desired value.

2. The method of claim **1** wherein the programming includes:

adjusting the setting of the selected wheelchair parameter to a desired value; and

updating the menu image with the adjusted value of the selected wheelchair parameter.

3. The method of claim **2**, further including saving the adjusted value of the selected wheelchair parameter in a designated memory location.

4. The method of claim **1** wherein displaying the adjustment image includes opening an adjustment window within the interactive display screen for displaying the value of the selected wheelchair parameter in a predetermined format, and wherein programming the setting of the selected wheelchair parameter to the desired value includes using the format of the adjustment window to adjust the setting of the selected wheelchair parameter to the desired value.

5. The method of claim **4** wherein the adjustment window format is displayed with a numerical value of the selected wheelchair parameter, and wherein the numerical value of the adjustment window is adjusted to the desired value.

6. The method of claim **4** wherein the adjustment window format is displayed with a graphical representation of the value of the selected wheelchair parameter, and wherein the graphical representation of the adjustment window is adjusted to the desired value.

7. The method of claim **4**, further including closing the adjustment window after the selected wheelchair parameter has been adjusted to the desired value, while continuing to display the menu image, wherein the menu image is updated to include the desired value for the adjusted wheelchair parameter.

8. The method of claim **1**, further including programming the setting of the selected wheelchair parameter to the desired setting using the displayed menu image.

9. The method of claim **1**, further including:

storing a plurality of menu images in a memory, each menu image including settings of a plurality of wheelchair parameters for a plurality of drive modes of the wheelchair; and

displaying menu images from the plurality of stored menu images on the interactive display screen according to a predetermined routing.

10. The method of claim **1** wherein the menu image is displayed in a table format with rows of wheelchair parameters and columns of drive modes.

11. An apparatus for programming parameters of a power driven wheelchair, comprising:

a display;

a controller for interacting with the display and operative to display a menu image on a screen of the display, wherein the menu image includes current settings of a plurality of wheelchair parameters for a plurality of drive modes of the wheelchair; and

one or more input devices operative to interact with the controller and the display to select a wheelchair parameter for a drive mode from the displayed menu image and to program the setting of the selected wheelchair parameter to a desired value;

wherein the controller is operative to open an adjustment image on the display for programming the selected wheelchair parameter setting in response to selection of the wheelchair parameter while continuing to display the menu image.

12. The apparatus of claim **11** wherein the one or more input devices is operative to control the controller to adjust a value of the selected wheelchair parameter to a desired value, and to update the displayed menu image with the adjusted value of the selected wheelchair parameter.

13. The apparatus of claim **12** wherein the one or more input devices is operative to control the controller to save the adjusted value of the selected wheelchair parameter in a designated memory location.

14. The apparatus of claim **12** wherein the one or more input devices is operative to control the controller to open an adjustment window within the screen of the display for dis-

playing the value of the selected wheelchair parameter in a predetermined format, and to adjust the value of the selected wheelchair parameter to the desired value using the format of the adjustment window.

15. The apparatus of claim **14** wherein the one or more input devices is operative to control the controller to display the selected wheelchair parameter in the adjustment window format with a numerical value, and to adjust the numerical value of the adjustment window to the desired value.

16. The apparatus of claim **14** wherein the one or more input devices is operative to control the controller to display the selected wheelchair parameter in the adjustment window format with a graphical representation of the value of the selected wheelchair parameter, and to adjust the graphical representation of the adjustment window to the desired value.

17. The apparatus of claim **14** wherein the one or more input devices is operative to control the controller to close the adjustment window after the selected wheelchair parameter has been adjusted to the desired value, while continuing to display the menu image, wherein the menu image is updated to include the desired value for the adjusted wheelchair parameter.

18. The apparatus of claim **1**, further including: a memory for storing a plurality of menu images in a memory, each menu image including settings of a plurality of wheelchair parameters for a plurality of drive modes of the wheelchair; and wherein the one or more input devices is operative to control the controller to display menu images from the plurality of stored menu images on the screen of the display according to a predetermined routing.

19. The apparatus of claim **18** wherein the one or more input devices is operative to control the controller to display a main menu image on the screen of the display, and to select for display other menu images of the stored plurality from the main menu image.

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